BELARUSIAN STATE UNIVERSITY

RESEARCH INSTITUTE FOR PHYSICAL CHEMICAL PROBLEMS

ГАНАРОВАЯ
ГРАМАТА
САВЕТА МІНІСТРАЎ
РЭСПУБЛІКІ БЕЛАРУСЬ

За значны ўклад у арганізацыю і практычную рэалізацыю вынікаў навуковых даследаванняў у Рэспубліцы Беларусь, падрыхтоўку кадраў вышэйшай кваліфікацыі ў галіне хіміі і хімічнай тэхналогіі ўзнагародзіць

УСТАНОВУ БЕЛАРУСКАГА ДЗЯРЖАЎНАГА УНІВЕРСІТЭТА "НАВУКОВА-ДАСЛЕДЧЫ ІНСТЫТУТ ФІЗІКА-ХІМІЧНЫХ ПРАБЛЕМ"

ГАНАРОВАЙ ГРАМАТАЙ
Савета Міністраў Рэспублікі Беларусь

Прэм'ер-міністр
Рэспублікі Беларусь С.С.Сідорскі

29 мая 2009 года
г. Мінск

The Research Institute for Physical Chemical Problems of the Belarusian State University was organized on the base of research groups worked at the chairs of BSU chemical faculty according to the decision of the Council of Ministers of the BSSR № 371 dated November 22nd, 1977 and the Institute begun to function since May 1st, 1978. After the state re-registration in 1999 it is referred to as the Establishment of the Belarusian State University «Research Institute for Physical Chemical Problems» (RI PCP BSU).

The main tasks of the Institute are:

- organization of R & D and carrying out of the work on the most topical problems of chemistry and related sciences; scientific and innovative activity in the field of chemistry and chemical technology;
- training of (in cooperation with educational divisions of the BSU) QSE with higher education on chemical specialties; development of scientific and pedagogical staff of the higher qualification Ph.D. and D.Sc. for the scientific-engineering complex and the national economy of Belarus as well.

The Institute was headed by the following scientists:

RAHMANOV Sergey Kimovich, Corresponding Member of the NAS of Belarus, D.Sc., Professor, Honored Science Worker of the Republic of Belarus (1993–1997).

IVASHKEVICH Oleg Anatol'evich, Academician of the NAS of Belarus, D.Sc., Laureate of the State Prize in Science and Technology of the Republic of Belarus, Honored Worker of BSU (1997-2009).

GAEVSKAYA Tatiana Vasil`evna was appointed as Director of the Institute in May, 2009, Ph.D., Associate professor.

KAPUTSKII Fyodor Nikolaevich, Academician of the NAS of Belarus, D.Sc., Professor, Honored worker of high school of the BSSR (1978–1979).

SVIRIDOV Vadim Vasil'evich, Academician of the NAS of Belarus, D.Sc., Prof., Honored Science Worker of the BSSR (1979–1993).

At present the Institute consists of 18 scientific divisions. 158 workers including 117 researchers are working in the institute. The research staff includes 5 D.Sc., four of them have the academic rank of the Professor and one of them is the Academician of NAS of Belarus, 62 Ph.D., 16 of them have the academic rank of the Associate professor. 11 D.Sc. including two Academician of the NAS of Belarus are working on the continuing base and realize scientific supervision in the institute divisions.

RIPCP BSU is one of the key institutions of the chemical specialization in Belarus. The Institute has been accredited by the State Committee on Science and Technology of the Republic of Belarus and National Academy of Science of Belarus and received a Certificate of Accreditation of the scientific organization № 1. The scientific and engineering potential of the Institute allows to solve complicated complex problems in different fields of chemistry and chemical technology and to realize the scientific and engineering support of the isolate manufactures and even some branches of chemical and pharmaceutical industries. The problems of wastes recycling and organization of low-capacity and science intensive chemical industries are among them.

The Institute carries out researching in the following areas:

• to investigate the regularities of nanocrystalline and amorphous metal, alloy, metal-oxide and complex-oxide materials synthesized by chemical, electrochemical and photochemical methods;

• to develop methods for modifying natural polysaccharides in order to increase their biological activity and the creation of new medicines;

• to investigate free radical reactions of biologically important substances and their simulate compounds; to develop methods of directed search and production of new pharmacologically active substances on the basis of free radical processes regulators;

• to develop energy-saving production technologies of organic substances;

• to synthesize and modify the inorganic materials on the basis of phosphates and metal oxides in order to develop sorbents and disinfectants;

• to develop effective methods for the synthesis of new organic compounds (polynitrogen, acyclic, heterocyclic, organophosphorous);

• to investigate by quantum-chemical methods the structure and properties of small clusters of transition metals, semiconductors and a number of azole compounds;

• to investigate the relationship «structure-function» for drugs and pharmacologically active substances of protein-peptide and steroid nature; to create transgenic strains of microorganisms for the directed synthesis of biologically active substances;

• to create new composite materials for technical, medical and agricultural purposes by chemical modification of natural and synthetic polymers;

• to develop new methods of separation, isolation, concentration and analysis of substances, as well as to create new materials, kits, devices and methods for medical diagnosis, environmental monitoring, quality control and certification of products on the basis of the research of extraction and sorption processes;

• to conduct the research work to ensure the activities of the republican bodies of state administration in the field of science, technology and innovation.

The Institute has been determined as a head organization-executor of the state scientific and technical programs such as «Pharmaceutical substance and drugs inventory» (subprogram of «Drugs inventory»), «Chemical technologies and manufactories» (subprogram of «Low-capacity chemistry»), state program «Innovation biotechnologies» (subprogram of «Bioenergetics, energy resources»), state scientific research programs such as «Chemical technologies and materials, nature-resort potential» for the period of 2011-2015.

The Institute is a leader in the Republic of Belarus in the fields of technologies for the

production of nanocrystalline and amorphous coatings from metals, alloys and composites on different substrates; drugs based on polysaccharides; technologies for structural and chemical modification of natural and synthetic polymers; technologies for complex processing of vegetable raw material for the production of diesel biofuel and other fuels; technologies for processing technogenic wastes containing precious metals. The results of the activities of the Institute in these areas up to now have a significant impact on the development of chemical-pharmaceutical and chemical industry, health care, engineering and instrumentation, as well as on the solution of the problem to create gold currency reserves in the Republic of Belarus.

The results of the Institute investigations were published in 65 monographs and collections of papers, conference materials, reference media and 34 tutorials for the students of chemical and other specialties (ten from them have the signature of the Ministry of Education of the Republic of Belarus). About 6 thousand scientific papers and more than 5 thousand abstracts have been published by the Researches of the Institute. RI PCP BSU tops the list of scientific organizations and educational institutions with the highest h-index in Belarus equal to 70, which is determined using the SCOPUS database.

Institute has received 923 safeguards including USSR 708 copyright certificates for inventions, 190 patents for inventions, 7 patents for utility model, 18 certificates of trademarks registration. Institute has 30 registered license agreements for the right of the industrial property usage.

In 2004-2014 the Institute`s developments were awarded to 2 special prizes, 47 medals (22 gold, 16 silver, 8 bronze and one special), 26 diplomas on the international exhibitions and shows.

Over the Institute lifetime the purposeful work connected with training of the researchers with high qualification has been carried out. 25 D.Sc. thesises and 202 Ph.D. thesises were fulfilled and defended in the Institute divisions, including 3 D.Sc. thesis and 21 Ph.D. thesis defended for the last 5 years.

Institute`s collective for the considerable contribution in organization and practical realization of the results of scientific research in the field of chemistry and chemical technology was awarded to Honourable Diploma of the Belarus Council of Ministers in 2009. According to the results of yearly republican competition between state scientific organizations and scientific service organizations RI PCP BSU in 2005-2012 yy. was recognized as the winner seven times and was marked on the Republican board of Honor by the Decrees of the President of the Republic of Belarus.

Institute`s collective (Prof. M. Artemyev, Academicians of NAS of Belarus A. Lesnikovich and O. Ivashkevich) for the cycle of works «New inorganic compounds and materials based on micro- and nanoparticles: preparation, properties and application» was awarded to the State Prize in Science and Technology of the Republic of Belarus (Presidential Decree N^0 401 dated September 9, 2013).

RI PCP BSU was recognized as the winner in the competition «The organization of inventive activity and the management of intellectual property» and was awarded to the Diploma of the National Intellectual Property Center in 2012.

The Certification Body for fuels and chemical products was created and accredited in RI PCP BSU in 2013, which is included in the Unified Register of certification bodies and testing centers of the customs union, Registration number of accreditation certificate is BY/112 100.01, valid until 27.12.2015. Scientific and production unitary enterprises «Unidragmet BSU» and «Unihimprom BSU» on production of import-substituting high-tech fine chemical products were established in the structure of the BSU in 1999-2001 on the basis of structural divisions, human resources and scientific and technological developments of the Institute in 1999-2001 yy.

Laboratory of physical chemistry and modification of cellulose

The laboratory was established in 1978. The Head of the laboratory is F. Kaputskii, Academician of NAS of Belarus, D.Sc., Prof., Honored Worker of High School of BSSR, Honored Worker of BSU, laureate of A.N. Sevchenko Prize - 2001. Kaputski F.N. was awarded to order «Honour mark», medal of Fransisk Skorina, medal for labour merit, in 2004 y. he received the Presidential Unite Citation.

Directions of the research activity:

• development of scientific bases of the structural and chemical modification of natural polymers.

Main achievements:

• scientific bases of processes of oxidation and dissolution of cellulose in systems containing nitric oxide(IV) have been developed to derive materials for medical and industrial purposes;

• cellulose nitrites has been isolated, identified and analyzed for the first time, heterophasic structural conversions of cellulose under the action of nitric oxide(IV) have been investigated, new methods for obtaining cellulose sulfa- and aceto ethers and structurally and chemically modified powdered forms of cellulose have been developed;

• methods of educing of xylan from raw wood and its subsequent sulfation have been developed, sodium salts of xylan sulfate esters with anticoagulant activity have been synthesized.

Developments:

• the technology of production of oxidized cellulose and a number of drugs based on it with hemostatic, antimicrobial, immunostimulatory effects has been developed and mastered at Co. Ltd «Borisovskiy zavod medicinckich preparatov»;

• comprehensive enterosorbent «Diasorb» based on chemically modified microcrystalline cellulose, designed for use in case of food, drugs and alcohol poisoning has been developed, the drug has been mastered at SPA RUE «Dialek»;

• psychotropic drug of prolonged activity «Litotsel» based on lithium poliuronate for treatment and prevention of mental diseases associated with affective episodes, manic, hypomanic states of various origins has been developed. The production of the drug has been mastered at SPA RUE «Dialek».

Laboratory of polysaccharides

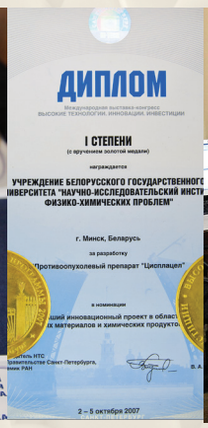
structural-chemical modification and drugs on their basis

The laboratory was established in 1998. The Head of the laboratory is T. Yurkshtovich, Ph.D., Associate professor, Honored Worker of BSU, laureate of A.N. Sevchenko Prize - 2001.

Directions of the research activity:

- chemical and structural modification of polysaccharides of microbial, plant and animal origin, investigation of etherification, alkylation and oxidation of polysaccharides, investigation of physicochemical and medico-biologic properties of modified polysaccharides for the creation of medical supplies;

- investigation of sorption interactions between chemically and structurally modified polysaccharides and biomacromolecules or low molecular weight physiologically active substances for the creation of systems for targeted delivery of chemotherapy;



• development of innovative medicines with targeted and prolonged action based on modified polysaccharides, development and implementation of technological processes of their production, development of modern ways of validating methods for qualitative and quantitative analysis of drugs.

Main achievements:

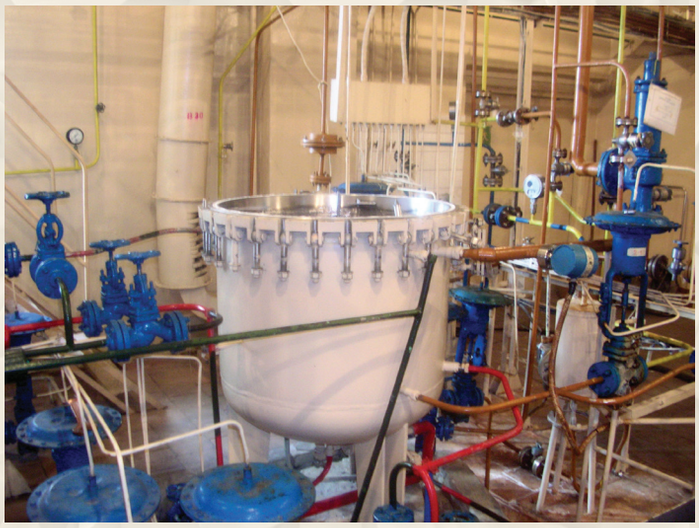
• new methods for synthesis of modified polysaccharides with different types of substituents and functional groups, which have their own intrinsic biological activity and are suitable for use as a polymer carrier, providing a prolongation of therapeutic effects and targeted delivery of the drug to the target organ have been developed;

• new methods for synthesis of gelling polysaccharide phosphates with a wide range of mono- and disubstituted phosphate groups, porous structure, high water absorbent capacity as well as the presence of anti-proliferative activity against HeLa tumor cells, have been developed;

• resource-saving and environmentally friendly method for preparing cationic starch for inside sizing of paper and board to accelerate the dehydrating of the pulp and increase the strength properties of the paper sheet have been developed;

• mechanisms of sorption interactions between oxidized polysaccharides and aliphatic amines, aminoacids, enzymes, antibiotics and cytostatics have been established; scientific-based approaches to drug adsorption on oxidized cellulose to produce bioresolving combined drugs with prolonged action have been developed;

• several methods of immobilization of antitumor drugs on the gelling polysaccharides phosphates have been developed, the impact of adsorptive interactions mechanism on the rate of the cytostatic agent release in the biological environment, the duration of the anti-proliferative effect have been determined; medicinal forms of temozolomide and prospidinum for use as means for local chemiotherapy of the brain and stomach tumours have been determined.



Developments:

• technologies of production of drugs in the form of bioresorbing napkins: «Polikapran» (hemostatics), «Film with lincomycin» (antimicrobial and hemostat), «Ferantsel» (antimicrobial and proteolytic), «Oksitselanim» (hemostatic, antimicrobial and immunostimulant) (silver medal at the VI Moscow International fair of innovations and investments in 2006 year), «Protselan» (antimicrobial, analgetic and restorative drug) (gold medal at the International Exhibition-congress «Hi-Tech. Investments. Innovations», St. Petersburg-2008); hydrophilic ointments «Linkotsel» and «Protselan» (antimicrobial, analgesic and restorative effect), «Film with lincomycin» and «Protselan» have been developed and implemented at Co. Ltd «Borisovskiy zavod medicinckich preparatov»;

• method for producing the original home antianginal drug «Nitargal» belonging to the class of organic nitrates has been developed (gold medal at the VIII Moscow International fair of innovations and investments in 2008; gold medal at the Technical Fair, St. Petersburg-2010); technology of producing the substance was mastered in UE «Unitechprom BSU», the finished dosage form «Nitargal tablets 20 and 40 mg» is produced now at the RUE «Belmedpreparaty»;

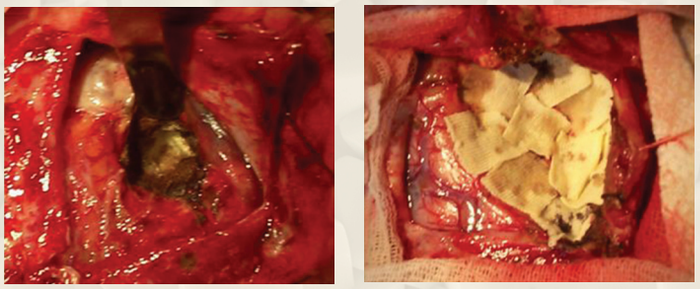
• the drug «Tsisplatsel» (bioresolving napkins based on modified cellulose with immobilized cis-diaminodichloroplatinum(II) having a hemostatic and prolonged antitumor effect and intended for local chemotherapy of malignant brain tumors, tumors of the head and neck has been developed and mastered in the production of UE «Unitechprom BSU» (gold medal at the International Exhibition-congress «Hi-Tech. Investments. Innovations», St. Petersburg-2007; gold medal at the IX Moscow International fair of innovations and investments in 2009; Grand Prix at the Technical Fair, St. Petersburg-2013);

• the ophthalmic drug «Lakemoks» with prolonged and protective antioxidant activity, designed for retreading corneal

epithelium (Diploma at the Technical Fair, St. Petersburg - 2010) has been developed, it has been mastered at RUE «Belmedpreparaty»;

• the anticancer drug «Temodeks» representing temozolomide immobilized on a gelling dextran phosphate has been developed, it is intended for intra-operative administration in the place of a malignant tumor removed for relief of residual tumor cells and prevention of metastasis (gold medal at the Technical Fair, St. Petersburg - 2012) ;

• the high-efficient non-waste technology of producing cationic starch with a dry method has been developed (gold medal at the Technical Fair, St. Petersburg - 2013) and it has been mastered at Co. Ltd «Novaia Drut».



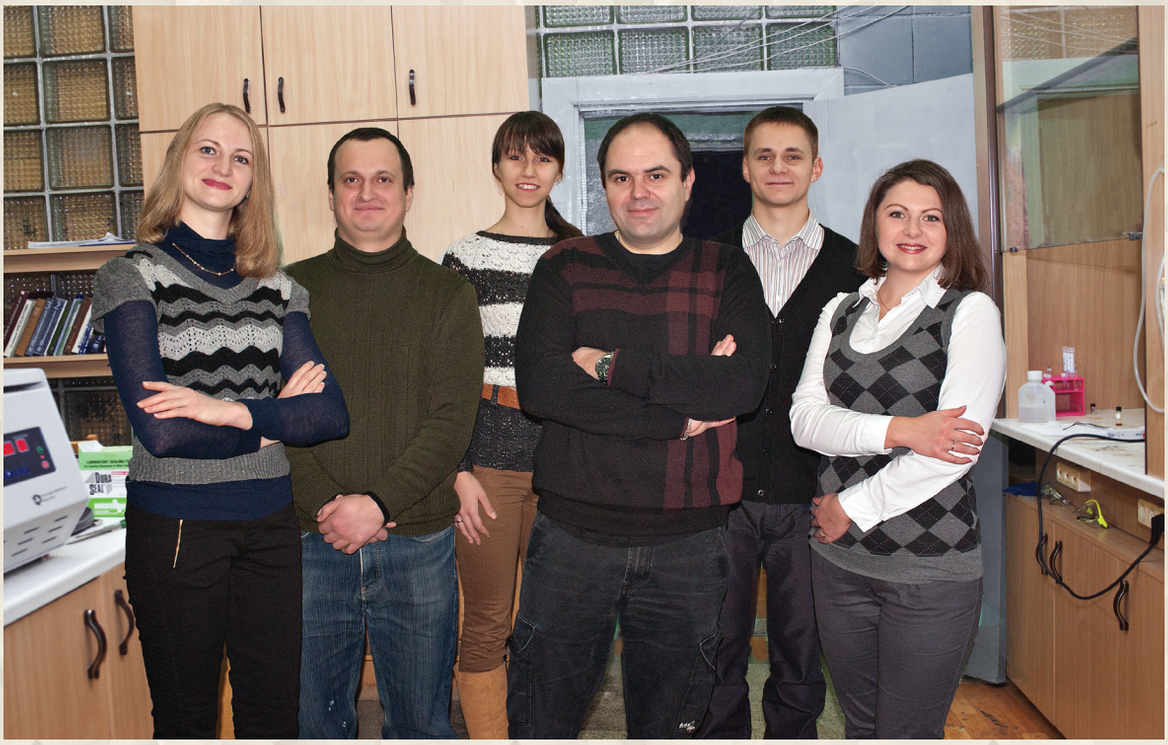
implantation of the drug «Tsisplatsel» in the bed of the removed brain glioma

Laboratory of catalysis of polymerization processes

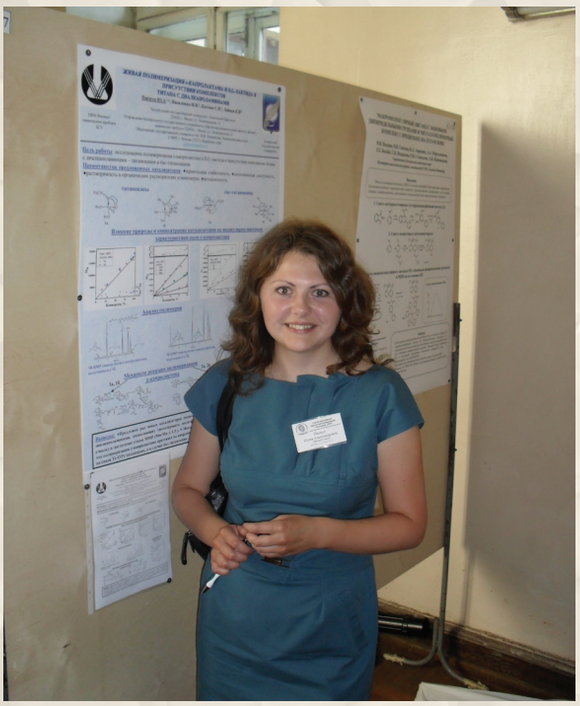
The laboratory was established in 2008. The Head of the laboratory is S. Kostjuk, Ph.D., Associate professor.

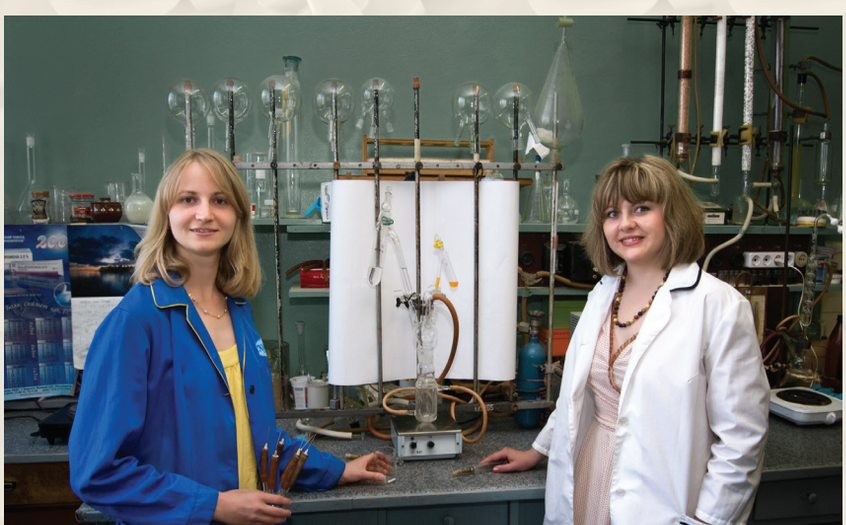
Directions of the research activity:

• traditional and controlled/«living» cationic polymerization of:



- vinyl monomers in aqueous medium (suspension, dispersion, emulsion);
- isobutylene, dienes and monomers isolated from renewable raw materials, on modified «classical» Lewis acids ($AlCl_3$, $RnAlCl_{3-n}$);





- development of new approaches to the synthesis of polyisobutylene with terminal olefinic groups;

• synthesis of the biodegradable (co)polymers based on ε-caprolactone, D,L-lactide and glycolide (search for new catalysts of (co)polymerization, synthesis of new biomaterials for regenerative medicine);

• synthesis of amphiphilic block copolymers with RITP method;

• development of methods for the synthesis and modification of petroleum resins based on oil refining industry waste - monomer C_5-C_9 containig fractions of pyrolysis;

Main achievements:

• a number of unique catalytic systems for the cationic polymerization in aqueous media and synthesis of functionalized isoprene, styrene and its derivatives oligomers has been developed;

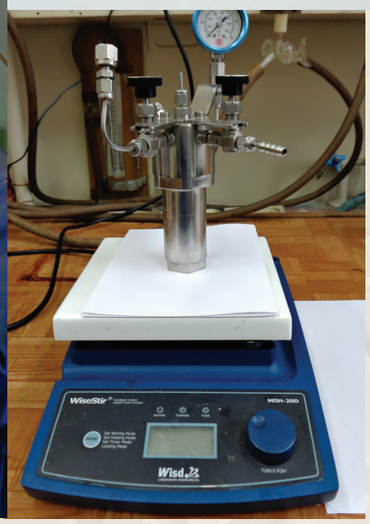
• available, cheap and efficient catalytic systems based on complexes of $AlCl_3$ ($EtAlCl_2$ and $BuAlCl_2$) with ethers for the synthesis of polyisobutylene with a high content of exo-olefinic end groups which are a key intermediate for the preparation of additives in motor oils and fuels have been proposed;

• effective catalysts for the synthesis of biodegradable (co)polymers with controlled molecular weight and narrow molecular weight distribution have been developed for use in regenerative medicine.

Developments:

• technology of production by a catalytic method of petroleum resins for use as a coating forming components in the lacquer paint compositions and sizing component of wood chipboard;

• technology of production of the oil polymer precursor by a catalytic method for use as a film-forming component in the lacquer paint compositions.



Laboratory of nanochemistry

The laboratory was established in 1978. The Head of the laboratory is M. Artemyev, D.Sc., Laureate of the State Prize in Science and Technology of the Republic of Belarus.

Directions of the research activity:

• colloidal chemical synthesis of micro-and nanostructured materials of inorganic or composite nature;

• directed chemical modification of the properties of nanostructures, surface functionalization;

•investigation of the fundamental optical, electrical and magnetic properties of nanostructured materials and their behavior in the chemical, physical, biological environments and processes;

• quantum-chemical modeling of the structure and electronic properties of metal and semiconductor clusters, depending on their size, chemical environment, being in a solid matrix and interpretation of the experimentally observed properties.

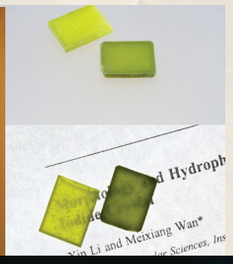
Main achievements:

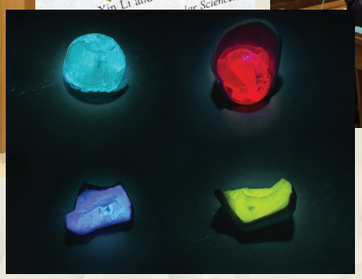
• original chemical and electrochemical methods for the preparation of super dispersed metals, oxides, quantum-dimensional semiconductors an composite systems on their basis have been developed and a set of physical and chemical properties of the materials has been investigated;

• fluorescent quantum-dimensional nanocrystals of $A^{II}B^{VI}$ compounds with unique optical properties, including a high luminescence quantum yield (over 50% at room temperature), precision-adjustable spectral range of emission from near UV to near IR area have been created;

• original scheme of sol-gel process, allowing to produce film and glassy solid materials based on silicon dioxide with nanoparticles of copper and its compounds has been developed;

• fibrous metals and metal alloys of the iron subgroup consisting of nanoparticles, self-





assembled in a magnetic field in a uniform thickness nanofibers have been synthesized; the effect of the self-organization of silver nanoparticles exposed to laser radiation into colloidal crystals and nanofibers has been established;

• the effect of the significant increase in the intensity of the luminescence of rare earth elements compounds and redistribution in the relative intensity of the luminescence transitions to longer wavelengths when silver nanoparticles are included into the oxide films containing lanthanide ions has been established;

• methods for the formation of monodisperse spherical particles of different chemical nature (silver, manganese carbonate, manganese dioxide) that can be used as inorganic micro templates for the formation of nano- and micro-reactors and containers based on hollow polyelectrolyte capsules have been developed;

• quantum-chemical model calculations of the state of silver and copper clusters of depending on their size, environment and being in a solid matrix were made and experimentally established properties have been interpreted;

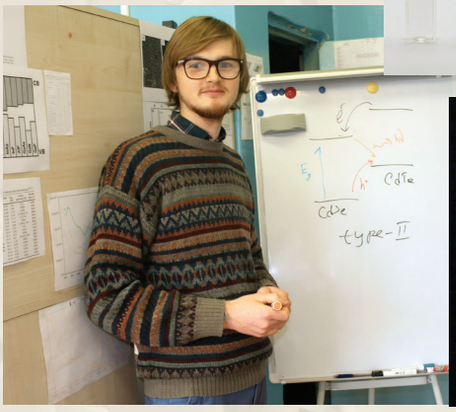
• methods have been developed and regularities have been established of electrochemical and photoelectrochemical deposition of monoatomic layers of metals (Pb, Cd, Bi, In, etc.) on the surface of Se, Te and metal chalcogenides.

Developments:

• technology of formation of high-compact scintillation transparent ceramics with high efficiency of radio luminescent based on super dispersed powders of yttrium aluminum garnet doped with Ce(III) ions and further comprising a lutetium oxide Lu_2O_3 nanoparticles has been developed;

•method of producing luminescent markers based on semiconductor nanocrystals of $A^{II}B^{VI}$ compounds for use as fluorescent labels in medical diagnostics has been developed;

• method of producing by sol-gel method quartz glasses with incorporated ultrafine particles of copper selenide as filters in the near-IR range has been developed.



Laboratory of thin film chemistry

The laboratory was established in 1988. The Head of the laboratory is T. Gaevskaya, Ph.D., Associate professor, Honored Worker of BSU, Layreate of A.N. Sevchenko Prize-2006.


ДИПЛОМ
О ПРИСВОЕНИИ ПОЧЕТНОГО ЗВАНИЯ
«МИНЧАНИН ГОДА»
В ОБЛАСТИ ВЫСШЕГО ОБРАЗОВАНИЯ И НАУКИ
Гаевской
Татьяне Васильевне
ДИРЕКТОРУ УЧРЕЖДЕНИЯ БЕЛОРУССКОГО ГОСУДАРСТВЕННОГО УНИВЕРСИТЕТА «НАУЧНО-ИССЛЕДОВАТЕЛЬСКИЙ ИНСТИТУТ ФИЗИКО-ХИМИЧЕСКИХ ПРОБЛЕМ»
ЗА ВЫСОКИЕ ДОСТИЖЕНИЯ В ТРУДЕ, ОСОБЫЙ ЛИЧНЫЙ ВКЛАД В СОЦИАЛЬНО-ЭКОНОМИЧЕСКОЕ И КУЛЬТУРНОЕ РАЗВИТИЕ ГОРОДА МИНСКА ПО РЕЗУЛЬТАТАМ РАБОТЫ ЗА 2010/2011 ГОД
ПРЕДСЕДАТЕЛЬ МИНСКОГО ГОРИСПОЛКОМА Н.А.ЛАДУТЬКО
СЕНТЯБРЬ 2011 ГОДА

Directions of the research activity:

• investigation of formation regularities, structure and properties of nanocrystalline and amorphous materials on the base of metals, alloys, obtained chemically, electrochemically and in the result of selective photo-deposition;


XX Международная выставка
ВЫСОКИЕ ТЕХНОЛОГИИ
ИННОВАЦИИ
ИНВЕСТИЦИИ
СПЕЦИАЛЬНЫЙ ПРИЗ КОНКУРСА
Лучший инновационный проект и лучшая научно-техническая разработка года
Санкт-Петербург
2014


ВЫСОКИЕ ТЕХНОЛОГИИ
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ДИПЛОМ

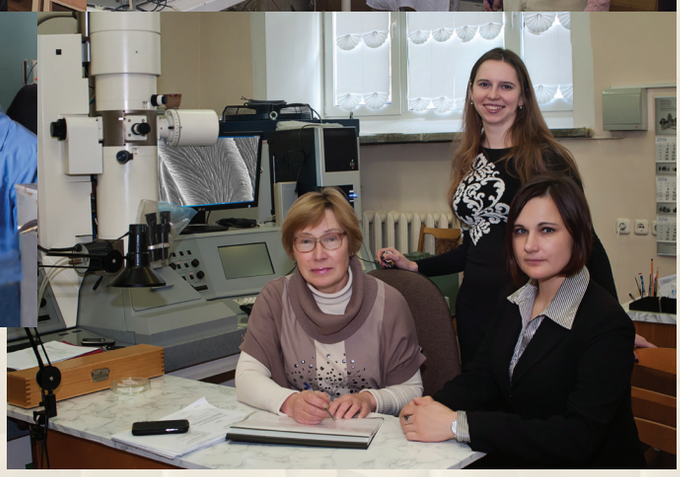
• development of novel impedance-spectroscopic and photoelectrochemical methods for investigation of the processes of metal and semi-conductor films formation;

• investigation of corrosion processes of metals and alloys using complex of electrochemical and spectroscopic methods;

• synthesis of complex oxide materials with a contolled structure determining their properties, creation on their basis of new high-performance, microheterogeneous, thin film photocatalysts, catalysts for pyrolysis and selective oxidation, adsorption-sensitive sensors;

▪ development of the technologies for deposition of functional (electroconductive, protective, anticorrosion, light-absorbing, antifriction, decorative and others) coatings on the base of

metals, alloys and composites for the goods of microelectronic applications, instrument-making and machine-building enterprises;



• development of scientific bases of recycling processes of various kinds of technology-related waste and chemical methods of the isolation of precious metals from them.

Main achievements:

• the principles of electrochemical and chemical synthesis of thin-film and thick-layer protective functional coatings of a new generation based on metals and alloys, as well as composite coatings with carbon nanomaterials and ultrafine metal oxides were scientifically proved and realized on practice, chemical and phase composition of the coatings, their structure and morphology, physical and mechanical, electrical and corrosion and chemical properties have been investigated;

• new method for the diagnosis of the energy state of the surface of the quantum dots, which allows to predict and control their stability and photoluminescence properties in various environments has been proposed based on a systematic investigation of the mechanism of the electrochemical oxidation-reduction of semiconductor nanoparticles;

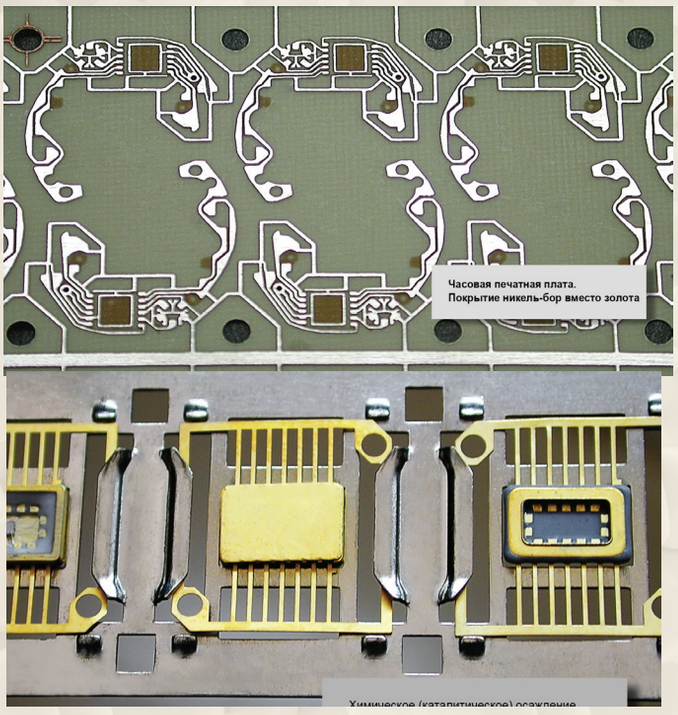
• new scientific direction in electrochemistry, the subject of which is the investigation of the frequency dynamics of the electrochemical response under controlled variable electrode potential was created, methods for production of multidimensional frequency characteristics of electrochemical systems (real and imaginary parts of the impedance as functions of both frequency

and electrode potential) and their computer analysis have been developed;

• fundamentally new photorecording material based on nanostructured titanium dioxide doped with noble metals ions, characterized by internal chemical amplification and the ability to invert the final image of the metal has been created based on the results of a comprehensive investigation of the kinetics and mechanisms of photocatalytic processes in the «wide gap-oxide-bimetallic nanoparticles» systems;

• technology of deposition of anticorrosive hybrid organic-inorganic coatings containing zirconia, titanium and silicon oxides nanoparticles, used for replacing existing chromium-containing primer coatings, applied on light alloys before plating of thick paint coatings has been developed;

• new approaches have been developed to the creation of anticorrosion coatings that provide self-healing of corrosion seats in which the delivery of a corrosion inhibitor to the site of the defect is achieved by the introduction of nanocontainers with the inhibitor (oxide nanoclusters, polyelectrolyte nanocapsules synthesized by LBL method, layered double metal hydroxides) into the hybrid sol-gel film;



• a new method of plasma-electroimplosion metal processing in solutions providing formation on the metal surface of low defect doped oxide films of various compositions with a new set of unusual properties, useful for engineering, microelectronics and medicine has been developed;

• a fundamentally new information in the field of synthesis of nanostructured complex oxide materials for various purposes was obtained, important structural parameters of the developed materials, allowing to control the gas sensing properties of sensors based on Fe_2O_3-In_2O_3 and catalytic properties of systems based on CeO_2-ZrO_2-La_2O_3 and CeO_2-Sm_2O_3 for hydrogen energy have been established;

• new approaches to the processing of industrial wastes of various types have been developed and implemented at the UE «Unidragmet BSU», which provide 10-50 fold enrichment of precious metals concentrates.

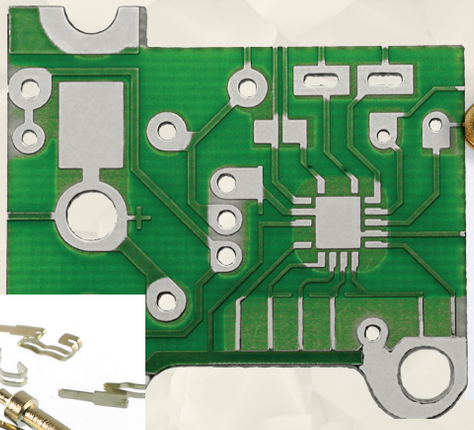
Developments:

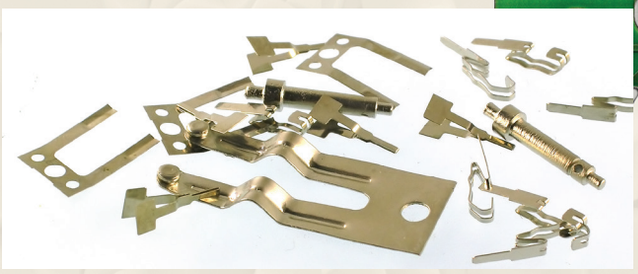
• technology of electrochemical deposition of nickel-boron alloy at a variety of products, instead of gold, silver, palladium, chromium, nickel (gold medal at the IV Moscow International fair of innovations and investments in 2004 year) has been implemented in the production of a number of enterprises of the Republic of Belarus and the Russian Federation which are: Co. Ltd «Minskii chasovoi zavod», Co.Ltd «Mogilevliftmash», Co.Ltd «Ecran» (Borisov), Co.Ltd «BelOMO» Vavilov plant» (Minsk), RUE «Molodechnenskii Radiozavod «Sputnik», Co.Ltd «Minskii electromechanicheskii zavod», PE «ENVA», Co.Ltd «BelTIZ» (Molodechno), Co.Ltd «Diatronik» (Minsk), Co.Ltd «Blick» (Tula), Co.Ltd «Nadezhda» (Miass, Chelyabinsk region), etc.;

• technology of electrochemical deposition of double-layer composite coatings of nickel-boron-diamond/iron for production of cutting discs has been implemented in series production of Co.Ltd «Gomelskoe IM Crystal» (Belarus), and IM «Crystal» (Smolensk, Russia);

• technology of electrochemical deposition of composite coatings of nickel-diamond-

ultrafine diamond and nickel-diamond-fullerenol on diamond cutting discs used for cutting semiconductor wafers on crystals has been implemented at Co. Ltd «Planar» (gold medal at Technical Fair «Hi-Tech. Innovation. Investments, St. Petersburg - 2010).





• technology for producing two-layer functional coating nickel-boron/immersion gold have been used in the manufacture of specialized contacts in the production of technical devices (oscilloscopes, voltmeters, power supplies, etc.) and medical supplies (hearing aids, glucometers) for the needs of «Elta-SAT», «Elta-SAT plus», «ISC-3» «Satellite express», «ISC-3», «Satellite express mini»);

• the laboratory has its own production of boron-containing composition for solutions of electrochemical deposition of nickel-boron, cobalt-boron and nickel-cobalt-boron coatings;

• technology of chemical deposition of gold coatings has been implemented at Co.Ltd «Coral» (Gomel) (silver medal at the V Moscow International fair of innovations and investments in 2005 year);

• technology of functional piezoceramic metallization;

• technology of aerosol-jet metallization of dielectrics for the production of conductive metal coating in the manufacture of electroforming copies (gold medal at the International Exhibition-congress «Hi-Tech. Investments. Innovations», St. Petersburg-2006)

has been implemented in series production of CC «Holographicheskaya industriya» (Minsk);

• technology for producing light-absorbing black composite coatings;

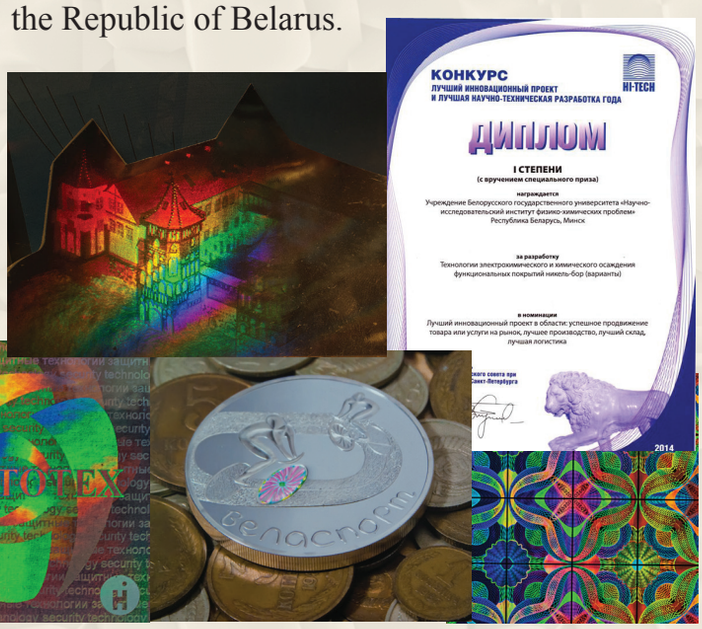
• technology of electrochemical deposition of copper and nickel on steel, cast iron and alloy products from zinc, aluminum and copper without undelayer (silver medal at the V Moscow International fair of innovations and investments in 2005 year);

• technology of deposition of copper-containing composite protective and decorative coatings;

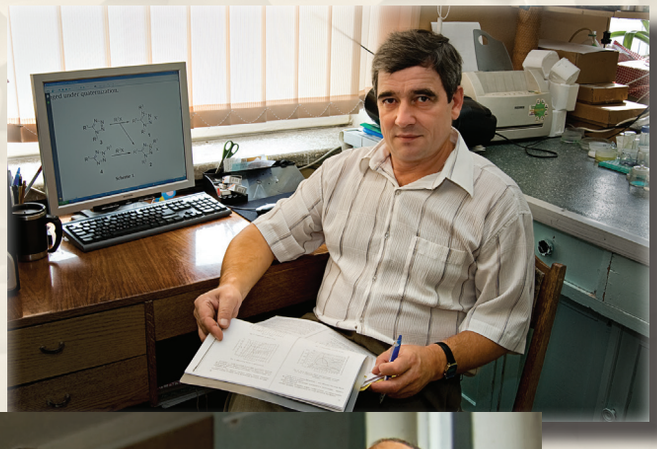
• technology of application of organic protective film on copper and copper alloys, providing solderability of copper surfaces and corrosion protection;

• technology options and solutions for sulphate peroxide etching of copper.

Collaborators of the laboratory Vorobyova T.N., Gaevskaya T.V., Stepanova L.I. were awarded to A.N. Sevchenko Prize -2006 for the investigations and development of the processes for deposition of metals, alloys and composite coatings from the solutions and their implementation at enterprises of the Republic of Belarus.



Laboratory for chemisrty of condensed systems



The laboratory was established in 1978. The Head of the laboratory is Yu. Grigoriev, Ph.D. Scientific Head of Laboratory is O. Ivashkevich, Academician of NAS of Belarus, D.Sc., Laureate of State Prize in Science and Technology of the Republic of Belarus.

Directions of the research activity:

• development of effective methods for the synthesis and investigation of the physical and chemical properties and structure of polynitrogen heterocycles (tetrazole derivatives, 1,2,3 and 1,2,4-triazoles), including their metal complexes, quaternary salts and polymers, promising in organic synthesis, medicine and technology;

• quantum chemical investigation of the structure and reactivity of the tetrazole derivatives and 1,2,3 – and 1,2,4 - trirazoles, structure and properties of small clusters of transition and noble metals;

• creation of new high-energy, gas-generating, anti-corrosion agents, sorbents of heavy and precious metals and materials of molecular electronics;

• development of effective ways of deriving and investigation of physicochemical properties of inorganic phosphates and compositions on their basis;

• development of technologies for the production of medicines, gas-generating systems, highly dispersed powders for purposes of criminalistic expert examination, polymeric materials of special purpose, motor fuels from renewable raw materials.

Main achievements:

• new concepts on the mechanism of interaction of electrophilic reagents with tetrazole substrates have been developed, effective methods for selective production of a wide range of 1-, 2-, 1,5- and 2,5-substituted tetrazoles and tetrazolium salts promising for the selective extraction of palladium from industrial palladium plating solutions, design of molecular ferromagnets, deriving ultrafiltration membranes, synthesis of practically important substances etc. have been developed;

• systematic quantum chemical investigation of the structure and physicochemical properties of a wide range of tetrazole derivatives and 1,2,3 or 1,2,4- triazoles has been conducted using modern nonobservational and DFT methods;

• a new type of self-organization at combustion of condensed systems has been established and investigated, which was called liquidflaming combustion;

• regularities of nanopowders production as well as colloidal dispersions of silver, copper oxide and hydroxide, zinc oxide, cadmium sulfide, copper and zinc, alloys of Ag-Pd and Ag-Pd in mixtures with barium titanate were investigated;

• systematic investigation of the electronic and geometric structure of some transition metals small clusters has been conducted, the results of which are important for understanding and predicting the catalytic activity of small clusters of transition metals in some processes;

• general peculiatities of phosphates crystallization based on investigation of phase equilibria in M_2O_3-P_2O_5-H_2O systems (where M is a trivalent metal) using the developed method of the thin layer from solutions and melts of phosphoric acids have been established, a new method for producing of double ammonium-containing condensed phosphates as promising fire-retarders of polymeric compositions based on polyamides has been developed;

thin-film capacitors;

• gas-generating systems for the cultivation of microaerophiles, anaerobes and caprophiles and the technology of their manufacture;

• the technology for production of biodiesel fuel from the rapeseed oil (gold medal at the X International Exhibition-congress «Hi-Tech. Investments. Innovations», St. Petersburg-2005, gold medal at the VIII Moscow International fair of innovations and investments in 2008 year);

• anti-friction and anti-wear additives to motor oils «Nikma»;

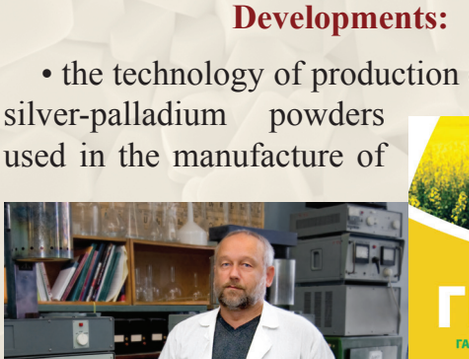
• powders and developers to indicate traces of hands during the criminalystic expertise (gold medal at the XI International Exhibition-congress «Hi-Tech. Investments. Innovations», St. Petersburg-2006, bronze medal at the IV Moscow International fair of innovations and investments in 2004 year);

• environmentally safe preparation for the pre-harvest treatment of rape «Gripil» (gold medal at X Moscow International fair of innovations and investments in 2010 year), production of «Gripil» has been organized at Co. Ltd «Stesmol»;

• technology for producing of drug «Forvaks« for the peroral lavage of the bowels has been mastered at JV Co.Ltd «Farmlend».

Developments:

• the technology of production of silver and silver-palladium powders used in the manufacture of



Laboratory of cellulose solutions and products of their treatment

The laboratory was established in 1988. The Head of the laboratory is D. Grynshpan, D.Sc., Professor, Honored Worker of BSU.

Directions of the research activity:

• creation of scientific bases for production and processing solutions on the base of cellulose and other polymers into fibers, films, membranes, composites;

• development of new approaches for the production of the quickly disintegrated solid and soft dosage forms on the base of activated carbon and water soluble polymers;

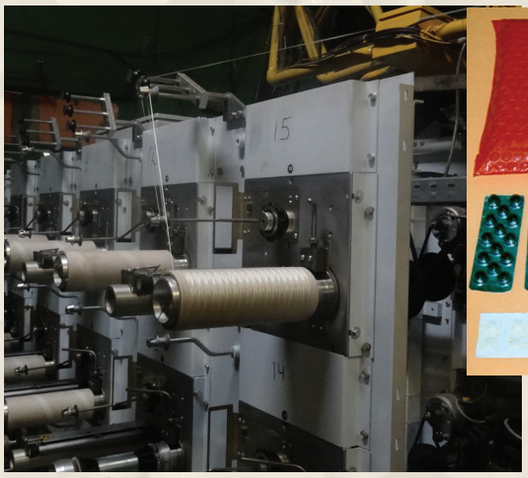
• development of new methods for treatment of polluted waters: the removal of the surface active substances and assident oil spill liquidation, production of composite biofuel on the base of hydrolytic lignin and petrolium and oil containing waste.

Main achievements:

• mechanisms for the direct dissolution of cellulose in mono- and bicomponent systems of different chemical nature have been revealed;

• new criteria for the evaluation of dissolving capacity of aqueous and non-aqueous systems according to natural polymer have been proposed;

• common concept for the solvation mechanism of cellulose dissolution in the solvents of different



chemical nature has been formulated;

• new methods for the cellulose dissolution and stabilization of the solutions containing two incompatible polymers in the common solvent have been developed;

• new method for synthesis of cellulose composite esters in the solutions has been worked out, this method provides the synthesis of low substituted cellulose derivatives with the uniform distribution of the substituents and complete solubility in aqueous and aqueous-organic media;

• homogeneous synthesis of mixed composite esters of cellulose, chitosan and chitin which form liquid crystalline structures in the super concentrated solutions has been developed for the first time.

Developments:

• environmentally safe, closed, non-carbon-disulfide technology for producing cellulose hydrate and structurally mixed with chitosan self-extinguishing fibers and filaments (gold medal on the International Exhibition-congress «Hi-Tech. Investments. Innovations», St. Petersburg-2012);

• technology for production of fibers, films, membranes and filtration tissues obtained from kinetically stable mixtures of cellulose with other high-molecular compounds;

• medicine on the base of activated carbon and a water-soluble cellulose derivative («Grand Prix» at the International CIS exhibition in Moscow, 2006):

- pills «Ultrasorb» for complex treatment of acute nettle-rash, atopic dermatitis, angioedema and others,

- hydrophilic ointment «Prednisolone Gel 0.5%» designed for complex treatment of inflammatory and allergic skin diseases,

• water-soluble derivatives of cellulose, chitin and chitosan for production of fast-disintegrating drugs of a new generation;

• the purification technology of surface, ground and waste water using solid composite reagents:

- mobile autonomous water treatment facility (gold medal on the International Exhibition-congress «Hi-Tech. Investments. Innovations», St. Petersburg-2007);

- regenerable filter-elements and compact filter devices on their base;

- portable cleaning kits for over contaminated surface and underground water;

- fast dispersible carbon sorbent and carbon coagulant for wastewater treatment;

• sorbent «Lignosorb» for removal of oil and assident oil spill liquidation and composite fuel based on it.

Laboratory of structural and chemical modification of polymers

The laboratory was established in 1989, The Head of the laboratory is L. Krul, D. Sc., Professor, Honored Worker of BSU.

Directions of the research activity:

• development of scientific bases for creation of materials based on water-soluble and biodegradable polymers;

• development of new methods for production of composite materials with controllable rheological, adhesive, electrical and optical properties;

• synthesis and investigation of new alicyclic and heterocyclic compounds for deriving polymers of different classes with increased resistance to heat and light aging.

Main achievements:

• principles of synthesis of adhesively-active and water-soluble polymers and creation on their base of adhesive compositions for glueing paper to glass and other hard surfaces as well as polyelectrolyte hydrogels with controlled water-absorbing and adhesive properties and good compatibility with the components of the protective-stimulating compositions in crop appointments have been developed;

• the ability has been proven to replace

titanium fixing elements used in domestic medical practice in the surgery of bone fractures in the maxillofacial area with the retainers on the basis of biodegradable polylactides obtained from lactic acid homopolymers that is important owing to possibility to exclude reoperation for removal of titanium retainers after bone healing;

• it has been determined that the phase structure of thin films of poly-L-lactide formed on the substrate during the deposition of active gas phase ensures their swelling in an aqueous medium, that permitted to justify appropriateness to use poly-L-lactide additives as a component of the antibacterial coating of implants accelerating the release of biocidal additives;

• method of polymethyl methacrylate modifying by copolymerization with polar monomers (acrylic acid and methacrylic acid, methacrylamide) that provides the synthesis of heat-resistant and thermostable organic glasses with good adhesion to silica glass, on the basis of which, a new polymeric material for recording of phase holograms used as microdisplay in automotive glass has been created;

• methods for synthesis of light heat stabilizers from class of hindered amines have been developed and the effectiveness of their stabilizing effect in polyolefins has been investigated;

• polystyrene scintillators for dosimetry and radiometry have been synthesized.

Developments:

• glue compositions based on water-soluble polymers;

• technologies of ε-caprolactam and industrial oil regeneration from industrial waste production;

• technology of production of polyelectrolyte hydrogels for pre-sowing treatment of crop seeds «Gisinar» (Bronze Medal at the VI Moscow International fair of innovations and investments in 2006 and Diploma at X International Exhibition-congress «High Tech. Innovations. Investitions», St. Petersburg -2005), technology has been masterd at Co.LTD Shayer group.

Laboratory of biochemistry of drugs

The laboratory was established in 1996. The Head of the laboratory is V. Shkumatov, D.Sc, Professor, Correspondent member of the NAS of Belarus.

Directions of the research activity:

• investigation of structure-activity relationships for peptides and proteins, using as medicines;

• development of transgenic microorganism for purposes of directed synthesis of biologically active substances;

• combined ultrasonic-enzymatic thrombolysis, use of enzymes in replacement therapy.

Main achievements:

• enzymatic microreactors for synthesis of radioactively-labeled steroids have been created based on the phenomenon of «molecular recognition»;

• a new experimental-theoretical model for estimating direct and side effects of the drug compounds has been proposed based on regularities of steroids transformations in transgenic microorganisms and methods of bioinformatics;

• enzyme activity of bacteria in relation to fluorescent analogues of cholesterol has been established, which is crucial to develop new methods for diagnostics of pathological conditions with participation of cholesterol;

• molecular mechanisms of pulsed low-frequency ultrasonic effect on the precursor molecules and active forms of several enzymes have been discovered in the development of a new ultrasonic-enzymatic treatment of thromboembolic conditions.

Developments:

• highly purified proteolytic enzymes such as α-chymotrypsin, trypsin, himopsin applyied in the isolation of racemates, resynthesis of peptide and ester bonds, chemical-enzymatic synthesis (own production);

• recombinant microorganisms for steroid synthesis;

• method of combined ultrasonic-enzymatic thrombolysis (in collaboration with RSPC «Cardiology» and Bellorussian Polytechnical Academy);

• protein-vitamin supplement to compound animal and bird mixed bodder on the basis of secondary products obtained in the production of biodiesel from rapeseed oil (silver medal at the Technical Fair, St. Petersburg - 2011);

• growth supplements to microbiological culture media developed in collaboration with Co.Ltd «SIC Chimmedsynthes» (Diploma at the Technical Fair, St. Petersburg -2011);

• series of enzymatic cleaners to remove contamination from different surfaces «Kryshtalin-F» developed in collaboration with Co.Ltd «SIC Chimmedsynthes» (silver medal at the Technical Fair, St. Petersburg - 2011);

• technology for proddction new medicinal form of the cardiac drug on the basis of phosphocreatine, kits of reagents for enzyme-linked immunosorbent assay for determination of troponins and markers of pathology of immune and allergic disorders developed in collaboration with JV Co.Ltd «Farmlend».

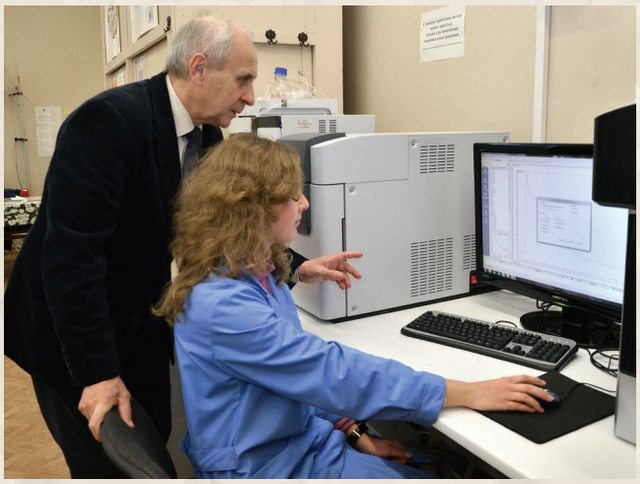
Laboratory of chemistry of free radical processes

The laboratory was established in 1999. The Head of the laboratory is O. Shadyro, D.Sc., Professor, Honored Worker of BSU, Layreate of A.N. Sevchenko Prize-2010.

Directions of the research activity:

• investigation of free-radical reactions of biologically relevant substances and the respective model compounds;

• development of new methods enabling a targeted search for pharmacologically active compounds among free-radical reaction inhibitors;



• development of new vegetable oil stabilization methods and development of biologycally active supplements based on them.

Main achievements:

• new free-radical fragmentation reactions occurring in carbohydrates, lipids, nucleosides, peptides, hydroxyl-containing amino acids and related compounds under the impact of various stress factors have been revealed;

• activity of nature compounds (flavonoids, phenylpropanoids, vitamins, coenzymes and other) and their synthetic analogs in the reactions with different organic radicals have been investigated and the basis of target search of the universal inhibitors preventing free-radical damages of biologically important substances have been worked out;

• about 200 derivatives of spatially hindered diphenols and aminophenols have been synthesized and tested for pharmacological activity, this resulted in the discovery of a new class of antiviral agents, as well as substances possessing neurotropic and anticancer properties;

• effective stabilizers for linseed oil have been found and biologically active additives have been developed on their basis.

Developments:

• antiherpetic drug «Butaminofen ointment» (gold medal at the V Moscow International fair of innovations and investments in 2005), its production has been mastered at RUE «Belmedpreparaty»;

• antiherpetic drug «Aktovir» based on the combination of two substances with different action mechanisms, its production has been mastered at RUE «Belmedpreparaty»;

• technology for production of foody, stabilized linseed oil based on the using of the vegetable raw composition (gold medal at the International Exhibition-congress «High Tech. Innovations. Investitions», St. Petersburg -2008) has been mastered at Co.Ltd «Club Farm-Eko»;

• production technologies of oxidation-resistant biologically active additives to food on the base of the linseed oil («Coenzyme Q10 - linseed oil plus», «Selenium - Vitamin E-linseed oil plus», «Beta-carotene - linseed oil plus», «Thistle oil - linseed oil plus») have been used at Co. Ltd «Club «Farm-Eco».

• technology for isolation of concentrate of E and F vitamins from the rapeseed oil (bronze medal at the VIII Moscow International fair of innovations and investments in 2008; medal of Academician I.N. Blokhin International Fund of Biotechnologies, 2008);

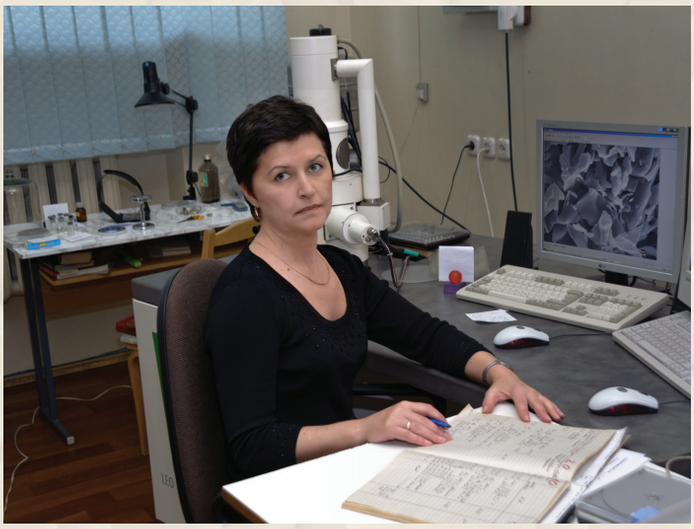
Laboratory of physicochemical investigations

The laboratory was established in 2002. The Head of the laboratory is L. Ivashkevich, Ph. D., Associate professor.

Directions of the research activity:

• x-Ray diffraction investigations of molecular and crystal structures of organic and inorganic compounds using both single crystals and powders;

• investigation of physicochemical processes of spontaneous and directed nanostructuring of silicon single crystal surfaces.



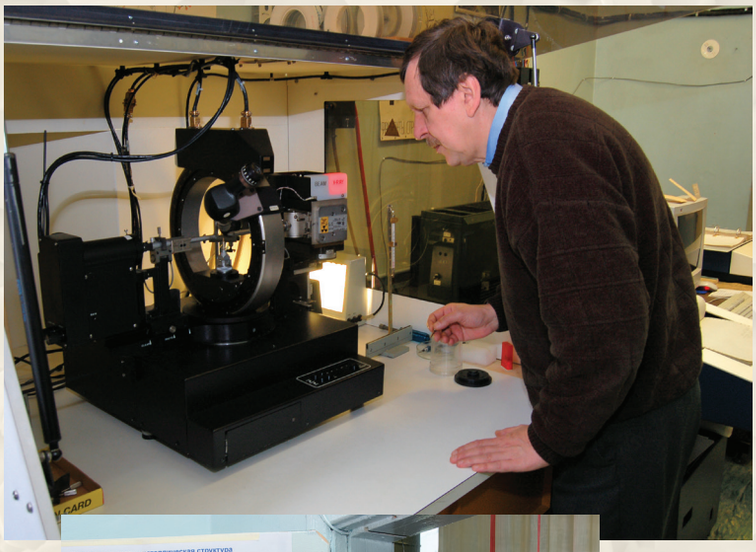
Main achievements:

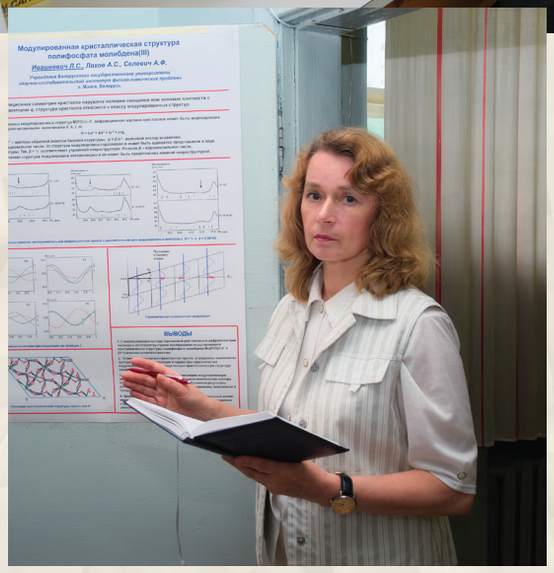
• crystal and molecular structure of more than 100 tetrazole derivatives has been determined, which represent complexes of tetrazoles with transition metals, substituted tetrazoles and tetrazolium salts:

- complete characteristic of crystal structure of the compounds (metric data, bond lengths, valency and torsion angles, coordination polyhedras,

packing of the molecules in the crystal, the system of hydrogen bonds and others) has been obtained,

- new ways of coordination of ligands have been identified and their relation to with the nature of the ligands has been established,





- ability of 1,5 - dialkiltetrazols to bridging coordination through the tetrazole cycle has been discovered,

- effect of differences in coordination properties inherent to 1H- and 2H- isomers of substituted tetrazols on the structure of coodinating compounds have been studied,

- influence of the nature of the tetrazole cycle substituents on the character of the crystal complex architecture has been investigated,

- spin state of iron(II) and cobalt(II) in complexes has been investigated on the basis of X-ray data,

- methodology of structural investigations of complexes by a powder diffraction method which permitted to establish the structure of a significant number of poorly-crystallizing compounds has been developed;

• crystal and molecular structure of 50 biologically active compounds (steroids, homogonanes etc.) has been established;

• a set of experimental and technological equipment to investigate regularities of nanomorphology transformation of solid surfaces in various physicochemical conditions has been created.

Developments:

• method of complete X-ray analysis of crystalline substances implemented into the practice of scientific research;

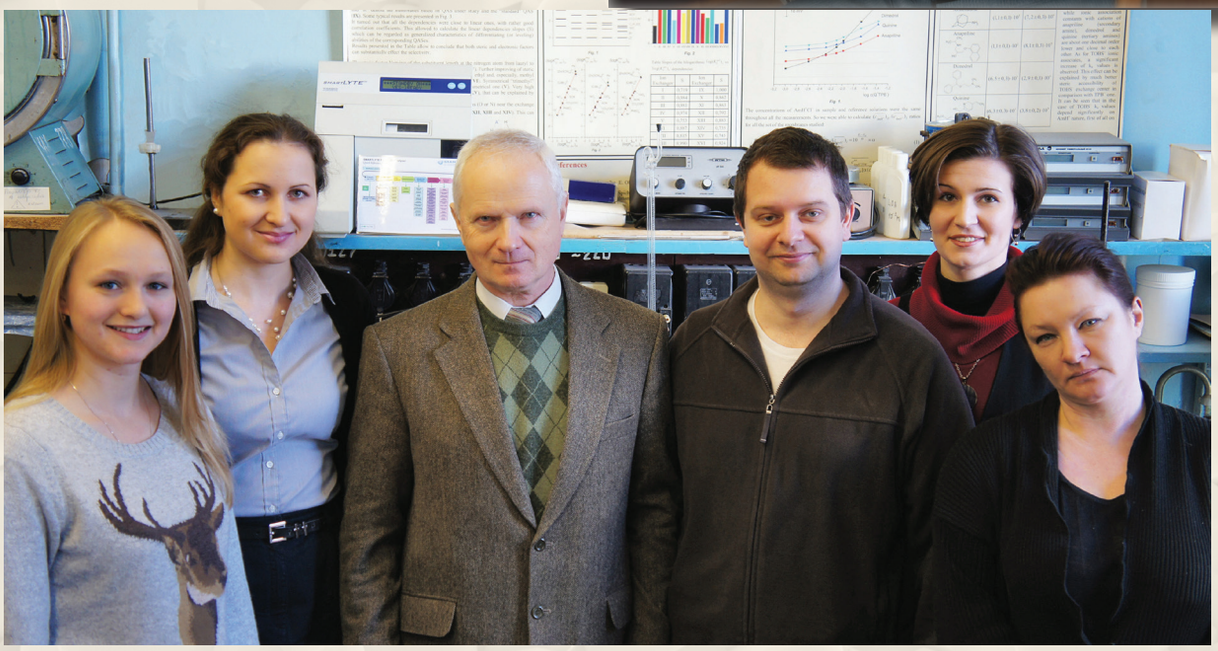
• a set of programs «Diamond» assighned for the computer simulation of the process of diamond type single crystals dissolution.

Laboratory of ionometry and chemical metrology

The laboratory was established in 1978. The Head of the laboratory is V. Egorov, D. Sc., Professor.

Directions of the research activity:

- synthesis of new liquid ion-exchangers and investigation of correlations between their structure and exchange selectivity;



- investigation of regularities of functioning of ion-selective electrodes with plasticized polymeric membranes based on the synthesized ion-exchangers and their compositions with neutral carriers;
- investigation of the influence of intramembrane and phase boundary equilibrium and diffusion processes on the membrane-solution boundary on the functioning of ion-selective electrodes;
- development of ion-selective electrodes for interoperation process control in pharmaceutical production;
- development of ion-selective microelectrodes for investigation of the corrosion processes.

Main achievements:

- higher quaternary ammonium salts which are derivatives of (2,3,4-trisdodecyloxy) benzylammonium chloride with variable steric accessibility of the exchange center $[C_{43}H_{79}O_3NR_1R_2R_3]+Cl–$, where R_1, R_2, R_3 are methyl, octyl or hydrogen atom in different combinations have been synthesized;
- ion exchange constants for a large number of single-charged and double-charged anions on the synthesed ion-exchangers have been determined;
- effect of the exchange selectivity increase to double-charged anions caused by the improvement in steric accessibility of the exchange center have been revealed and theoretically substantiated, the

above effect manifests itself in potentiometric selectivity as well, that allow improving the selectivity coefficients for sulfate, oxalate and hydrogenphosphate anions by 4–8 orders;

• constants of intramembrane equilibria have been determimed, that are constants of ionic associations of a number of anions with higher quaternary ammonium cations and conditional constants of anions complexation with the ether n-hexyl triftoratsetilbenzion acid; the influence of the ion exchanger nature on the values of these constants has been clarified; the influence of intramolecular hydrogen bond in the ions under study on the effectiveness of intramembrane ion interactions has been revealed;

• strong effect of the diffusion factor on the ion-selective electrodes analytic characheristics in the solutions on strongly discriminating ions have been found; method for determiming undistoreted (thermodinamically agreed) selectivity coefficients have been suggested;

• main principles for selectivity control of ion-selective electrodes reversible to physiologically active amine cations of different structure have been stated and particular ways for selectivity improvement have been proposed.

Developments:

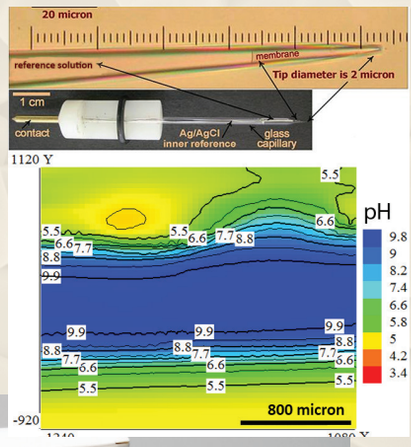
• sulfate-selective electrode;

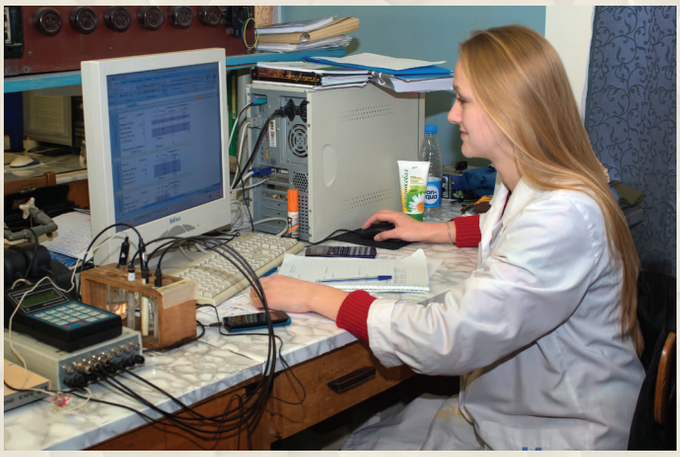
• express technique for potassium determination by potentiometric titration with sodium tetraphenylborate using potassium-selective electrode;

• ion-selective electrodes for determination of physiologically active amines, anions of non-steroidal analgetics, penicillines and techniques of their analytical applications;

• universal electrode and unitized technique for hydrophobic physiologically active amines determination in drugs by precipitation-potentiometric titration till fixed potential;

• H^+, Na^+, Cl^- – selective microelectrodes for the investigation of corrosion processes by the local scanning potentiometry.





Laboratory of fire retardant material

The laboratory was established in 1996. The Head of the laboratory is V. Bogdanova, D. Sc., Professor, Honored Worker of BSU.

Directions of the research activity:

• synthesis and investigation of the physicochemical properties of the metalsilico phosphate compounds to create materials for multifunctional use (extinguishing and fire retarding means);

• creation of effective combustion retardants for materials of different chemical nature;

• investigation of the mechanism of extinguishing an fire retardant action of nitrogen-phosphorus-containing compounds in natural and synthetic polymers of different classes;

• development of new technologies directed to extinguishing of smouldering materials with fire extinguishing compositions;

Main achievements:

• identity of the processes providing the dominant contribution to the inhibition of synthetic and natural combustible materials burning has been established, general principles of reducing the inflammability of different materials have been formulated and experimentally proved;

• reasons stipulating the extinction of combustible materials of different chemical nature that are synthetic and natural polymers and peat have been established;

• ways to improve known fire retardants and to

synthesize new means of extinguishing have been proposed and experimentally proved;

• retardants and extinguishing agents for wood and peat have been synthesized;

• nitrogen- and phosphorus- containing fire retardants for polyolefins and filled rigid polyurethane foam have been synthesized.

Developments:

• halogen-free polymer compounds and compositions with a reduced amount of antimony oxide for the manufacture of parts of electronic equipment, building materials and insulation of cable products;

• fire retardant coating for cable insulation «Penoterm-K»;

• atmosphere resistant chemical composition for the prevention and extinguishing of forest fires «Metaphosil» (bronze medal at the IV Moscow International fair of innovations and investments in 2004), manufacturing of the composition has been implemented at Co.Ltd «Gomel chemical plant»;

• composition to extinguish peat fires «Tofasil» (bronze medal at the IV Moscow International fair of innovations and investments in 2004);

• dismantling technology of stator windings of electric motors with a hydrolytic method (silver medal at the XIII International Exhibition-congress «Hi-Tech. Investments, Innovations», St. Petersburg-2008);

• flame resistant polyester nonwoven fabric and its production technology (gold medal at the XV International Exhibition-congress «Hi-Tech. Investments, Innovations», St. Petersburg-2010);

• hars combustible heat insulating composite material based on polyurethane for multiple purposes (gold medal at the Technical Fair, St. Petersburg - 2013).

Laboratory of inorganic sorbents and anticorrosive coatings

The laboratory was established in 2001. The Head of the laboratory is V.Shablovskii, Pd.D.

Directions of the research activity:

• modification of inorganic polymeric materials containing phosphates and d-metal oxides with the aim to create on their basis selective sorbents, anticorrosive and antifouling coatings;

• development of technologies for the production of phosphate anticorrosive coatings and pigments, inorganic sorbents based on hydroxides, phosphates, d-metals silicates as well as activated carbon for medical purposes;

• creation of new hemosorbents;

• creation of disinfectants belonging to a new generation based on organic peracids for sanation of facilities and equipment in the food, dairy and meat industry, agriculture;

• creation of new acid, alkaline, enzymatic technical detergents for equipment cleaning in the food, dairy and meat industry;

• development of heat-resistant materials on the basis of phosphate and silicate binders (adhesives, coatings, thermal protective, lining, fire retarding materials with a maximum operating temperature of 1600 ºC).

Main achievements:

• physicochemical properties of d-metals phosphates have been investigated, compositions of phosphating concentrates for the treatment of metal surfaces, rust converters, anticorrosive pigments have been worked out;

• methods for production of a number of highly selective inorganic sorbents based on oxides and phosphates of d-metals for drinking water purification, electroplating waste draines refinement and sewage treatment, including radioactive liquid-waste draines have been worked out and physicochemical properties of these sorbents have been studied;

• original schemes for production of a number of liquid disinfectants on the basis of organic carboxylic peracids for sanation of facilities and equipment at the enterprises of the dairy and meat industry, agriculture houses, as well as powdered disinfectant have been developed;

• one-step technology for granular coal hemosorbent production for medical purposes have been developed for the first time.

Developments:

• phosphating concentrates for corrosion protection KFP-1, KFP-3, FP-3 (Diploma at the VII Moscow International fair of innovations and investments in 2007);

• rust transformer «Superantikor» (Diploma at the VII Moscow International fair of innovations and investments in 2007);

• sorbents FT and FLAM for water purafication, electroplating waste draines refinement, wine materials purafication from heavy metal ions and ammonium;

• coagulant-flocculant for treatment of drinking water, municipal and industrial wastewaters;

• disinfectants «Valisan» for sanation of agricultural facilities (silver medal at the VII Moscow International fair of innovations and investments in 2007), «Valisan-2» for sanation by aerosol method of cow-houses, «Valisan-ZhKH» for decontamination of facilities for drinking water supply, «Valisan-K» for the prevention and treatment of purulent necrotic lesions of the cattle extremities, production of the disinfectsnts has been mastered at SPA Co Ltd «Navigator» and Co Ltd «Belsanvet»;

• disinfectant «Supersept» for sanitary purification of the equipment at cattle dairy farms and complexes for the production of milk (bronze medal at the VIII Moscow International fair of innovations and investments in 2008), its production has been mastered at SPA CoLtd «Navigator»;

• disinfectant «Nadkarbosept» for the sanation of farm animal houses;

• disinfectants: «Navisan-1» for the complex, «cold» disinfection of equipment and premises at the enterprises of the food industry, household and residential premises, vehicles (silver medal at the XIII International Exhibition-congress «Hi-Tech. Investments. Innovations», St. Petersburg-2008); «Navisan-vet» for processing of facilities and equipment of slaughterhouses at meat- processing plants; «Navisan-Agro» for processing of vegetable stores before storage of products; «Navisan-DD» for simultaneous disinfection and disinfestation of agricultural premises; «Navisan-NM» for enzyme, acid and alkaline cleaning of membranes in installation for milk whey condensing;

• disinfectant with detergent effect «Tubisan» for complete inactivation of the pathogens of tuberculosis in places of cattle maintance; its production has been mastered at Co.Ltd «Bikrask».

• disinfectant «Meladez» for processing molasses of yeast production;

• disinfectants «Sanitek» and «Sanitek-2» for sanitizing facilities and equipment in the food processing industry;

• thermostable materials with a working temperature 1600 °C:

- glueing compositions for metals, ceramics, glass, wood, graphite;
- fireproof materials: lining, repair and masonry mortars;
- composite materials including textolites;
- unfired ceramics, paints, compounds;
- neutron- and microwave absorbing screens.

Laboratory of fuels, vegetable oils and feeds

The laboratory was established in 2005. The Head of the laboratory is Z. Antonova, Ph. D., Associate professor.

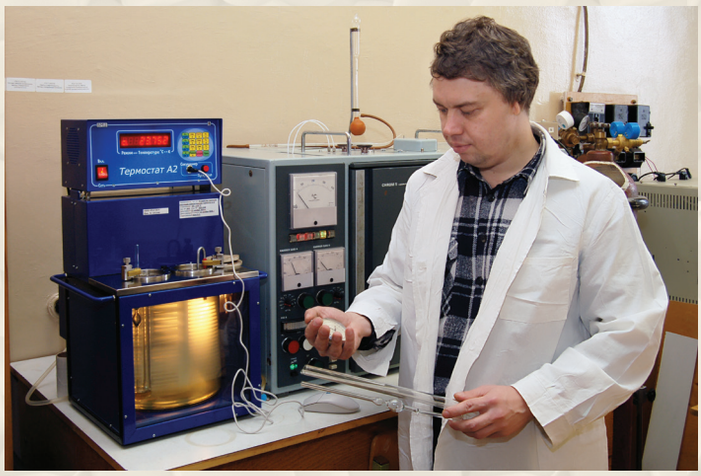
Laboratory of fuels, vegetable oils and feeds complies with the criteria of the National Accreditation System of the Republic of Belarus and is accredited for compliance with the requirements of STB ISO/IEC 17025 (Accreditation Reg. № BY/112 02.1.0.0463). The laboratory is included in the Unified Register of certification bodies and testing laboratories of the Customs Union. The scope of accreditation includes a list of tests for solid and liquid fuels, solid and liquid biofuels, building materials, petroleum products, motor oils, gear oils, vegetable oils, animal feed, compound feed, press cakes, protein meals, oilseeds under more than 100 technical regulations.

The certification body for fuels and chemical products has been created and accredited, which is included in the Unified Register of certification bodies and testing centers of the Customs Union. Registration number of accreditation certificate is BY/112 100.01.

Directions of the research activity:

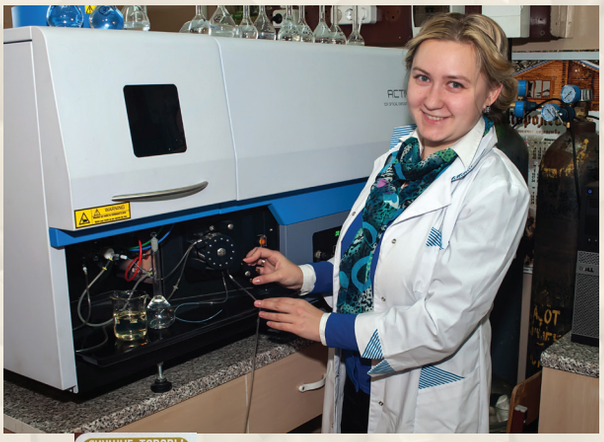
• investigation of thermodynamic properties of organic compounds for the thermodynamic grounding of energy and resource-saving technologies of organic and petrochemical synthesis;

• development of technologies of deriving new types of solid and liquid fuels, including biofuels from renewable raw materials;



• development of measurement techniques for quality control of fuels, oils, feeds;

• testing physical, chemical, and operating properties of fuel and chemical products.



Main achievements:

• dependencies of physicochemical properties (oxidation stability, combustion energy, iodine number, density, viscosity, etc.) of vegetable oils, individual esters of fatty acids and their model compounds, as well as commercial samples of the methyl esters of fatty acids obtained with various technologies, on the fatty acid composition have been established and empirical equations have been proposed;

• energy and exergy analysis of fatty acids methyl and ethyl esters production, including all stages from seeding to producing a marketable product has been conducted for assessment of the effectiveness of biodiesel production;

• dependence of solid biofuels combustion heat on the nature of raw materials, moisture, ash and elemental composition has been investigated, and physicochemical characteristics of fuel pellets depending on production conditions and properties of the raw material have been determined.

Developments:

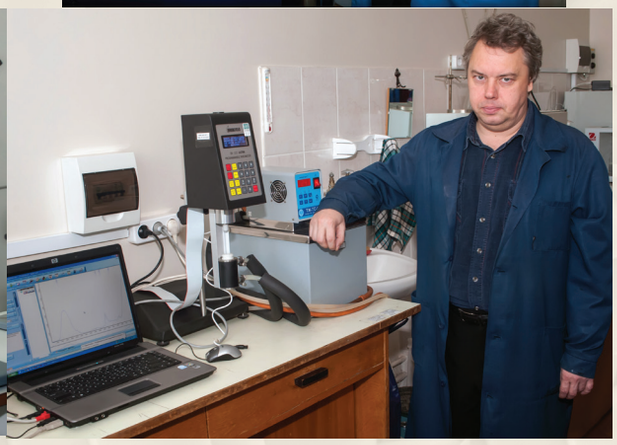
• technology of the processing of methanol formed at the production of polybutylene terephthalate at Co. Ltd «Mogilevkhimvolokno»;

• the first in Belarus means for measuring the calorific value of solid and liquid fuels «Bomb Calorimeter isoperibolic BIC-100»;

• formulation and production technology of mineralorganic complex micronutrients for foliar feeding of rapeseed;

• complex vitamin and mineral supplements in the feed «Feed additive (substance) with an optimal set of micro- and macro-elements» and «Complex vitamin and mineral supplement «Feed phospholipid complex», «Feed additive «Phospholipids»;

• technology of liquid mixed fuel oils «Residual fuel modified», «Fuel mixture modified» production.



Sector of organic substances thermodynamics

The sector was established in 1991. The Head of the department is A. Blokhin, D.Sc., Professor.

Directions of the research activity:

• experimental investigation of thermodynamic properties (heat capacity, parameters of phase transitions, vapor pressure, combustion enthalpy) of organic materials and ionic liquids;

• carrying out of statistical calculations of thermodynamic functions of substances;

• development of scientific foundations for forecasting of thermodynamic properties of organic substances; physicochemical grounding of energy and resource-saving technologies of organic synthesis;

• development of energy- and resource-saving technologies of industrial organic synthesis; development of technologies for production of biofuels from renewable plant resources.

Main results:

• measurements of thermodynamic properties of the following groups of substances have been conducted: basic, intermediate and final products of caprolactam production; carbamide and its alkyl or phenyl derivatives; a number of products of dimethyl terephthalate production; cyclohexane and cyclopentane derivatives; adamantane and its derivatives, cell hydrocarbons, low-temperature ionic liquids;

• information databases for the products of caprolactam and carbamide has been created;

• methods for predicting thermodynamic properties of substances have been developed based on the classical theory of molecular structure for derivatives of carbamide, oxygen-containing aromatic organic compounds, etc .;

• existence of additivity of thermodynamic properties of substances in the crystalline state has been proven, and restrictions in predicting thermodynamic properties of crystals have been determined;

• parameters of the original thermochemical environmental model for the calculation of chemical exergy have been grounded, additive calculation methods for chemical exergies and methods of their determination for multicomponent fuels and materials have been developed;

• method of configuration integral calculating for statistical calculations of the thermodynamic properties of molecules in liquid has been developed;

• model of the energy states of molecules in plastic crystals of organic substances has been grounded;

• various types of polymorphism in crystals of low-temperature ionic liquids with organic cations have been established;

• methods of correlation calculations of enthalpy of vaporization for molecular ionic liquids have been developed.

Developments:

• modes of countercurrent heat exchange in cyclohexanol dehydrogenation reactor of caprolactam production;

• scheme for catalyst filling in the reactor of hydrogenation of benzene;

• modes of exhaustive drying of cyclohexanone oxime in the production of caprolactam;

• technology for deriving solid fuel (pellets) from biomass of rapeseed and straw cereals;

• technology for solid fuel production from biomass of energy-intensive crops.

Laboratory of biomass conversion

The laboratory was established in 2011. The Head of the laboratory is V. Simirskiy, Ph.D.

Directions of the research activity:

- investigation of physicochemical properties of individual compounds and their mixtures and also investigation of natural biopolymers which are the potential sources of mechanical, electric or thermal energy;
- investigation of processes of production and using new solid, liquid and gaseous fuels based on renewable sources of raw materials;
- development of methodological, normative technical and other documentation relating to the processes of production and using new types of fuels for different purposes.

Developments:

- technology of deriving environmentally friendly heat carrier for local heating of residential and industrial premises;
- technology for deriving bioethanol from starch-containing raw materials.

Innovation division

The division was established in 2003, the Head of the division is Yu. Nechepurenko, Ph.D, Honored Worker of BSU.

Directions of the activity:

• conduction of market research to promote scientific and technological products created in the Institute at the domestic and foreign markets;

• normative, methodological and consulting support of the Institute departments on the creation, legal protection and use of intellectual property offices, patent-licensing;

• organizational and legal support for the transfer of the results of scientific and technological activity created at the Institute, including license basis, to potential customers;

• information support of the departments of the Institute in carrying out research, development and engineering works;

• carrying out advertising and exhibition activities;

• conduction of research work to ensure activities of the republican government bodies in the field of science, technology and innovation.

Main achievements:

• the system of intellectual property management at the branch and corporate levels has been developed;

• RI PCP BSU was recognized as the winner in the competition of 2012 year «Organization of inventive activity and management of intellectual property» and was awarded to the Diploma of the National Center for Intellectual Property;

• 150 applications for issuing protective documents for industrial property rights facilities were filled, 139 patents for inventions, 6 utility model patents were obtained, 17 trademarks were registered in the patent office in 2004-2014;

• 30 licensing agreements for the right to use the results of scientific and technical activities, containing objects of industrial property rights have been entered into agreement in 2004-2014;

• developments of the Institute presented in the 2004-2014 have been marked with the Grand Prix, 47 medals (22 gold, 16 silver and 8 bronze and one special) and 26 diplomas at international exhibitions fairs and shows.

Research Institute for Physical Chemical Problems of the Belarusian State University

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Republic of Belarus,
220030, Minsk, Leningradskaya st. 14
tel: +37517 2265141; fax: 2264696
e-mail: fhp@bsu.by,
site: http:/www.fhp.bsu.by

Director	Gaevskaya Tatiana Vasil`evna, Ph.D., Associate professor tel.: +375 17 2095254 gaevskayatv@bsu.by
Vice director on scientific work	Nechepurenko Yuri Vasil`evich, Ph.D. tel.: +375 17 2095186 nuv@bsu.by
Vice director on innovation work	Cherniavski Eugenii Anatol`evich, Ph.D. tel.: +375 17 2095194 eugene.cherniavsky@gmail.com
Scientific secretary	Vrublevskaya Olga Nikolaevna, Ph.D., Associate professor tel.: +375 17 2264702 fhpprogram@gmail.com
Chief accountan	Molofeeva Natalia Euhen`evna tel.: +375 17 2008927 natali_molofeeva@mail.ru